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Health-Promotion Intervention Increases Self-Reported Physical Activity in Sub-Saharan African University Students: A Randomized Controlled Pilot Study

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Abstract

To evaluate the efficacy of a health-promotion intervention in increasing self-reported physical activity among university students in Sub-Saharan Africa. Randomly selected second-year students at a university in South Africa were randomized to an intervention based on social cognitive theory: health-promotion, targeting physical activity and fruit, vegetable, and fat consumption; or HIV risk-reduction, targeting sexual-risk behaviors. Participants completed assessments via audio computer-assisted self-interviewing pre-intervention and 6 and 12 months post-intervention. 176 were randomized with 171 (97.2 %) retained 12 months post-intervention. Generalized-estimating-equations analyses indicated that the health-promotion-intervention participants were more likely to meet physical-activity guidelines than were control participants, post-intervention, adjusting for pre-intervention physical activity (odds ratio [OR] = 3.35; 95% CI: 1.33-8.41). Health-promotion participants reported a greater number of days they did vigorous-intensity (risk ratio [RR] = 2.01; 95% CI: 1.43-2.83) and moderate-intensity (RR = 1.40; 95% CI: 1.01-1.95) aerobic activity, but not strength-building activity (RR = 1.37; 95% CI: 0.091-2.07). The intervention reduced self-reported servings of fried foods (mean difference = −0.31; 95% CI: −0.60, −0.02). The findings suggest that theory-based, contextually appropriate interventions may increase physical activity among university students in Sub-Saharan Africa.

Keywords

Randomized controlled trial; physical activity; health-promotion intervention; 5-a-Day diet; Social cognitive theory; Sub-Saharan Africa; University students

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Over the past 30 years, the prevalence of non-communicable diseases (NCDs) has been rising worldwide, and now NCDs are the world's leading killers, causing more deaths than all other causes combined [1]. Nearly 75% of the world's 38 million NCDs-related deaths during 2012 occurred in low-and-middle-income countries. Each year 8 million people below the age of 60 years in low-and-middle income countries die from preventable NCDs, including cardiovascular diseases, hypertension, cancer, and diabetes. The risk of these diseases is associated with certain behaviors, including physical inactivity and inadequate fruit-and-vegetable consumption.

There is growing recognition of the impact of NCDs on morbidity and mortality in South Africa.[2-4] NCD behavioral risk factors, particularly physical inactivity, are prevalent in South Africa. For instance, a national survey found that 46.6% of female and 31.3% of male black South Africans 15 to 24 years of age engaged in insufficient physical activity [5]. Another national survey found that 42.4% of female and 34.4% of male black pubic high school students engaged in insufficient physical activity [6].

Few physical-activity interventions have been rigorously evaluated with South Africans [7-12]. Most physical-activity interventions have been developed, implemented, and evaluated in developed countries [10, 11]. Two recent randomized controlled trials (RCTs) of health-promotion interventions in South Africa, one on young adolescents [13] and one on men [14, 15], found significant increases in physical activity.

Students encounter challenges during the transition from high school to university, a transition that provides freedom from parental supervision, often accompanied by changes in behavior, including decreased physical activity [16]. Based on a review of the scientific literature [17], guidelines for physical activity [18] were developed that recommended a combination of aerobic activity and strength-building activity because evidence linked both types of physical activity to reduced risk of NCDs and all-cause mortality. Here we report a RCT testing the efficacy of an intervention to increase adherence to those physical-activity guidelines and other healthful behaviors among university students in South Africa. The intervention was developed based on behavior-change theories [19, 20], integrated with extensive formative research, including focus groups [21] and surveys [22-25] with the target population.

We hypothesized that the health-promotion intervention would increase self-reported adherence to physical-activity guidelines during a 12-month post-intervention period compared with an attention-matched control group. Secondary outcomes included fruit-and-vegetable consumption and fried food intake.

Methods

The Institutional Review Board of the University of Pennsylvania and the Ethics Committee of the University of Fort Hare approved the study. The study was conducted at a university located in a rural area in Eastern Cape Province, South Africa. In November 2008, toward the end of the academic year, the university's administration provided a list with names, gender, nationality, and contact details of all first-year students. Using computer-generated random number sequences, from the 1,469 first-year students, we randomly selected and invited to participate 244 such that the sample would include equal numbers of male and female and South African and non-South African students. Those who were 18 to 24 years of age and who did not plan to leave the university within the following 12 months were eligible.

Eligible students were invited to participate in "Wake-up!," a health-promotion project. As compensation, the students were offered a t-shirt with the study logo, a certificate of completion, and a grocery-shop voucher of R120 at post-intervention assessment; a portfolio with the study logo and a grocery-shop voucher of R60 at the 6-month follow-up; and a backpack with the study logo and a grocery-shop voucher of R100 at the 12-month follow-up. At the time of informed consent, R1 was worth about $0.10 US dollars.

All participants gave written informed consent before enrollment. After returning to the university in January 2009 for their second academic year, eligible students were invited to attend the baseline data collection. Those who completed the baseline assessment were invited to attend a separate session at which computer-generated random number sequences were used to randomize them to the health-promotion or attention-matched control intervention. A biostatistician conducted the computer-generated random assignments; the principal investigator, Dr. Heeren, implemented the assignments. South African and non-South African and male as well as female students were randomly assigned separately to ensure that nationality and gender were balanced across the interventions.

Intervention Methods

Each intervention consisted of 8, 45-minute modules, with 2 modules implemented during each of 4 weekly sessions. Each intervention was highly structured and involved interactive exercises, games, brainstorming, role-playing, videos, and group discussions implemented in mixed-gender groups of 7 to 11 participants (mean group size = 8.8) led by co-facilitator pairs using standardized intervention manuals.

The health-promotion intervention was designed to increase knowledge, attitudes, self-efficacy, and skills to prevent NCDs by increasing physical activities, choosing healthy diets, and limiting alcohol use. Formative research was conducted and all activities were pilot tested to ensure the appropriateness of the intervention and to determine whether the games, videos and exercise aids, such as pedometers and rubber bands for strength building, would be accepted by the population [21].

Table 1 presents the outline of the health-promotion intervention. In a health-assessment activity, participants recorded their health-related behaviors to understand how and where they could make changes to reduce their risk for NCDs. Participants learned and practiced different types of physical activity: (a) aerobic, defined as activity that increases the ability of the heart, lungs and systems of blood vessels to supply oxygen and nutrients to the body to move further, and longer, with less effort (b) strength building, defined as activity that builds muscle; and (c) flexibility increasing, defined as activity that increases the ability to move around easily and safely through a range of motion.

Consistent with physical-activity guidelines, we encouraged participants to engage in a combination of aerobic and strength-building exercises each week: (1) at least 30 minutes of moderate-intensity aerobic activity on 5 days or at least 20 minutes of vigorous-intensity aerobic activity on 4 days and (2) strength-building activity on at least 2 days [18]. During the intervention, participants exercised to upbeat South African music. Because self-efficacy is confidence in the ability to perform a behavior despite obstacles, an important element of the intervention was brainstorming to identify the participants' barriers to exercising, commonly including lack of motivation, interest, time, and physical ability, and concrete ways they could surmount them.

Other activities covered the 5-a-Day recommendation, defined as consuming 5 to 9 servings of fruits and vegetables daily, and the "South African Food Pyramid" and addressed barriers to healthful eating that focus groups identified, including cost, taste and availability of fresh produce, and strategies for overcoming them. Participants learned ways to prepare healthy meals, avoiding excess fat and fatty sauces, and to improve their own cooking recipes and to avoid frying and to substitute healthful for unhealthful food choices. A closing ceremony was conducted during which the participants received certificates of completion.

The attention-matched control intervention, focused on HIV risk-reduction, had the same number of sessions as the health-promotion intervention and was designed to control for "Hawthorne effects" to reduce the likelihood that the health-promotion intervention's effects could be attributed to its nonspecific features, including group interaction, and special attention [26]. As reported elsewhere, it was designed to reduce unprotected sexual intercourse and multiple sexual partnerships [27].

The co-facilitators were 16 graduate students at the university (6 women and 10 men) 24 to 49 years of age (mean = 27.6; SD = 5.6) who had previously worked as HIV peer educators. We randomized them to a 5-day training to implement 1 of the 2 interventions, thereby randomizing facilitators' characteristics across interventions. During the training, the trainers modeled the intervention activities and the facilitators practiced implementing them, received feedback, and created common responses to potential issues that might arise during implementation. The importance of fidelity to the intervention and protecting participants' confidentiality was emphasized.

Data Collection and Measures

The participants completed confidential surveys pre-intervention and 6 and 12 months post-intervention via audio computer assisted self-interviewing (ACASI). Physical activity was assessed with 3 open-ended items the Centers for Disease Control and Prevention [28] developed: On how many of the past 7 days, did you exercise or participate in physical activity for at least 20 minutes that made you sweat and breathe hard, such as jogging, aerobic, soccer or similar physical activities? On how many of the past 7 days, did you exercise or participate in physical activity for at least 30 minutes that did not make you sweat or breathe heard, such as walking or anything else that caused small increases in breathing or heart rate? On how many of the past 7 days, did you do push-ups or sit-ups?' The primary outcome was a binary variable, used in previous research [13, 15, 29], indicating whether the participant met the physical-activity guideline. Participants were defined as meeting the guideline if they engaged in strength-building activity on at least 2 days and engaged in either 20 minutes of vigorous activity on at least 4 days or 30 minutes of moderate activity on at least 5 days [18].

A 7-item food frequency questionnaire developed by the National Cancer Institute to evaluate 5-a-Day studies was used to measure fruit-and-vegetable consumption over the past 30 days [30]. The items concerned 100% orange or grapefruit juice, other 100% juices, fruit, green salad, fried potatoes, other potatoes and other vegetables (e.g. In the past month [30 days], about how often did you drink 100% orange juice or grapefruit juice? with eight categories from did not drink 100% orange or grapefruit juice in the past month to five or more times per day). Total consumption was computed by summing individual item scores [31]. A binary outcome, used in previous research [13, 29], was calculated indicating whether the participant met the 5-a-Day guideline of eating at least 5 servings of fruit and vegetables daily in the past 30 days.

To facilitate the participants' ability to recall their behavior, they were asked to report their behaviors during a brief period (i.e., past 3 months, 30 days or 7 days). The dates comprising the period were written on a whiteboard. Additionally, they were given calendars where they could highlight the periods of concern. The importance of responding honestly was stressed, informing them that their responses would be used to create programs for other students like themselves and such programs would be effective and accurate only if the participants answered the questions honestly. The peer co-facilitators were not involved in data collection, and data collectors were blinded to participants' intervention.

Sample Size and Statistical Analyses

Sample size and power for this trial, based on the HIV/STI risk-reduction intervention, are described elsewhere [27]. Chi-square and t-tests were used to identify variables that predicted attrition. The efficacy for the health-promotion intervention was tested using logistic, Poisson, or linear generalized estimating equations (GEE) regression models[32] depending on the type of outcome variable (binary, count, or continuous, respectively). The models included baseline measure of the criterion, intervention, time (two categories representing 6- and 12-month follow-up), gender, age group (coded 18 to 20 years and 21 to 24 years), nationality (South African vs. non-South African), and the Intervention-Condition x Nationality interaction. An exchangeable working correlation matrix was specified in the estimation of the model parameters and robust sandwich estimators of the standard errors were used.

We report odds ratios (OR) for binary outcomes, meeting physical-activity and 5-a-Day diet guidelines, risk ratios (RR) for counts, number of days of vigorous-intensity and moderate-intensity aerobic activity and strength-building activity, and mean differences for all other behaviors, which were linear outcomes, and corresponding 95% confidence intervals. We report Cohen's d, an effect size estimate in standard deviation units [33] calculated using the Cox method for odds ratios [34] and the Z-test statistic and N from the GEE analysis for continuous and count variables. Analyses were performed using an intent-to-treat mode with participants analyzed based on their intervention assignment regardless of the number of intervention or data-collection sessions attended. All analyses were completed using SAS V9.3.

Results

Figure 1 shows the flow of participants through the trial. Of the 1469 first-year students attending the university, 244 were randomly selected and 240 were eligible. Of these, 201 completed the baseline assessment, and 176 (73.3%) were randomized. Among the eligible students, only 64 (53.3%) South Africans compared with 112 (93.3%) non-South Africans were randomized (χ^2 = 49.09, N = 176, p = .0001). The percentage of eligible women and men randomized did not differ significantly.

Table 2 summarizes the characteristics of the participants at baseline by intervention. Participants were 18 to 25 years of age (mean = 20.8) and 53.4% were women. Most (86.4%) participants lived on campus. About 36.4% were South Africans, 58.0% were Zimbabweans, and 5.7% were from other African countries. About 35.8% reported having problems with alcohol on the CAGE, and 4% reported using dagga (marijuana) in the past 30 days.

Attendance at all intervention and data-collection sessions was excellent. A total of 173 (98.3%) attended Intervention Session 1, and 156 (88.6%), 161 (91.5%), and 170 (96.6%) attended Sessions 2-4, respectively. The number of sessions attended did not differ by any of the variables in Table 1, with the exception of nationality. South Africans (mean = 3.41) attended fewer intervention sessions than did Non-South Africans (mean = 3.95), $F(1, 174)$ =33.83, $p < .0001$. A total of 173 (98.3%) attended at least 1 of the 2 follow-up data-collection sessions, 171 (97.2%) attended the 6-month and 171 (97.2%) attended the 12-month follow-up. Attending a follow-up was unrelated to the variables in Table 1 or the behavioral outcomes, with one exception. The more days on which the participants used marijuana in the past 30 days, the less likely they were to attend a follow-up session, OR = 0.64, 95% CI: 0.47-0.88.

Effects on Outcome Variables

Table 3 presents the descriptive statistics for the health behaviors by intervention and assessment. Table 4 presents the estimated intervention effects unadjusted and adjusted for baseline prevalence. Only 18% of the participants met the guidelines for both aerobic and strength-building physical activity at baseline; irrespective of intervention arm, the percentage reporting adherence to the guidelines increased significantly at 6 (27%; p = .008) and 12 months post-intervention (27%; p = .016), compared with pre-intervention. As hypothesized, the health-promotion intervention significantly affected the primary outcome, increasing self-reported adherence to the physical-activity guidelines, compared with the attention-matched control intervention, adjusting for pre-intervention adherence to physical-activity guidelines. The intervention also significantly increased the self-reported number of reported days the participants engaged in vigorous- and moderate-intensity aerobic activity compared with the control intervention. However, it did not significantly increase strength-building activity compared with the control intervention.

Although the health-promotion intervention did not increase adherence to the 5-a-Day guideline or servings of fruits or vegetables, it decreased the self-reported number of servings of fried food compared with the control intervention. There was a significant Nationality x Intervention interaction on vigorous aerobic activity, $Z = 2.91$, $p = .004$. The health-promotion intervention caused a greater increase in vigorous aerobic activity among South Africans, RR = 2.08, 95% CI, 1.48-2.93, $p < .001$, than among non-South Africans, RR = 1.07, 95% CI, 0.84, 1.37, $p = .594$. The only other significant Nationality x Intervention interaction was in the unadjusted-for-baseline analysis of servings of fried food, $Z = 2.01$, $p = .044$. The health-promotion intervention caused a greater decrease in servings of fried foods among South Africans, mean difference = −0.32, 95% CI, −0.61, −0.04, $p = .026$, than among non-South Africans, mean difference = 0.01, 95% CI, −0.15, 0.18, $p = .864$.

Discussion

As hypothesized, the health-promotion intervention increased self-reported adherence to physical-activity guidelines, the primary outcome, compared with the attention-matched control group, adjusting for baseline adherence. Only 18% of the participants at baseline met the physical-activity guidelines, which recommend a combination of aerobic and strength-building activity each week: strength-building on at least 2 days and either vigorous-intensity aerobic activity for at least 20 min on at least 4 days or moderate-intensity aerobic activity for at least 30 min on at least 5 days. Analyses also revealed that the intervention increased the self-reported number of days on which the students engaged in vigorous- and moderate-intensity aerobic activity, as compared with the control group, though it did not significantly increase strength-building activity.

Although there are growing calls for physical-activity interventions to reduce health risks [35, 36], few RCTs have tested the effects of such interventions in sub-Saharan Africa, particularly among university students. One study, using a quasi-experimental pre-post design, found that South African university women in a 10-week aerobic exercise program had improved BMI, waist and hip circumference, and blood pressure immediately post-intervention compared with pre-intervention, but did not examine longer-term outcomes. Two RCTs with South Africans found that interventions improved physical activity during a 12-month post-intervention period, but one was with young adolescents [13] and the other was with adult men [15]. Other studies testing physical-activity interventions with South Africans have not employed RCT designs[37] or have had brief follow-up periods [38]. Thus, this study, consistent with epidemiological studies highlights the low levels of physical activity among young South African adults, and shows for the first time that a theory-based and contextually appropriate health-promotion intervention can be effective in increasing self-reported adherence to physical-activity guidelines among sub-Saharan university students.

The intervention employed in this study, developed based on behavior-change theories integrated with qualitative research on the target population, can be disseminated to universities in sub-Saharan Africa to address the low levels of physical activity among students. Employing a peer educator model makes the intervention cost-effective compared with the alternative of employing professionals as facilitators; moreover, peer educators may be better able to establish rapport with fellow students and to motivate them to attend the multiple intervention sessions. A RCT comparing peer educators and professionals who facilitated HIV risk-reduction or health-promotion interventions found that the adolescent participants randomized to the peer-educator conditions liked the interventions more and the facilitators more than did those randomized to professionals [39].

The strengths and limitations of this research should be considered in evaluating the findings. The strengths include the use of behavior-change theories, the use of extensive qualitative research to tailor the theories to the population, the pilot testing of the interventions, the use of a RCT, the dose-equivalent control group, and the high attendance at intervention sessions and retention at data-collection sessions. A limitation of the intervention is that, although it increased self-reported physical activity, it did not increase adherence to the 5-a-Day diet, a surprising finding in light of the extensive intervention content focused on fruit-and-vegetable consumption. On the other hand, the intervention did reduce self-reported fried food consumption. It may be that increasing students' fruit-and-vegetable consumption is especially difficult in this rural university setting. Perhaps more structural interventions, changing the food choices available to students, are needed. Future research must address this issue.

Although we planned to have a sample that was one-half South African and one-half non-South African, we did not reach this goal. We do not know why the enrollment rate was lower among South Africans. Additional research must identify strategies to encourage South African students to participate, particularly since they appeared to benefit from the health-promotion intervention at least as much as did the non-South African students. Another limitation of the study is the use of self-reports of behavior. Although using ACASI may have reduced the impact of social desirability response bias,[40] future research should employ objective measures of physical activity to confirm the present findings. Although we randomly selected students from the university, the university itself was not randomly selected; accordingly, whether the findings generalize to students at other universities in South Africa is unknown.

In conclusion, the findings support the view that health-promotion interventions based on social cognitive theory and the theory of planned behavior when integrated with formative research with the target population can be efficacious in increasing self-reported adherence to physical-activity guidelines among university students in South Africa. These findings are consistent with accumulating evidence on the utility in sub-Saharan Africa of cognitive-behavioral theories developed in the West. By implementing theory-based physical-activity interventions, it may be possible to reduce the burden of NCDs tied to physical inactivity, a burden that is growing in South Africa and other sub-Saharan African countries.

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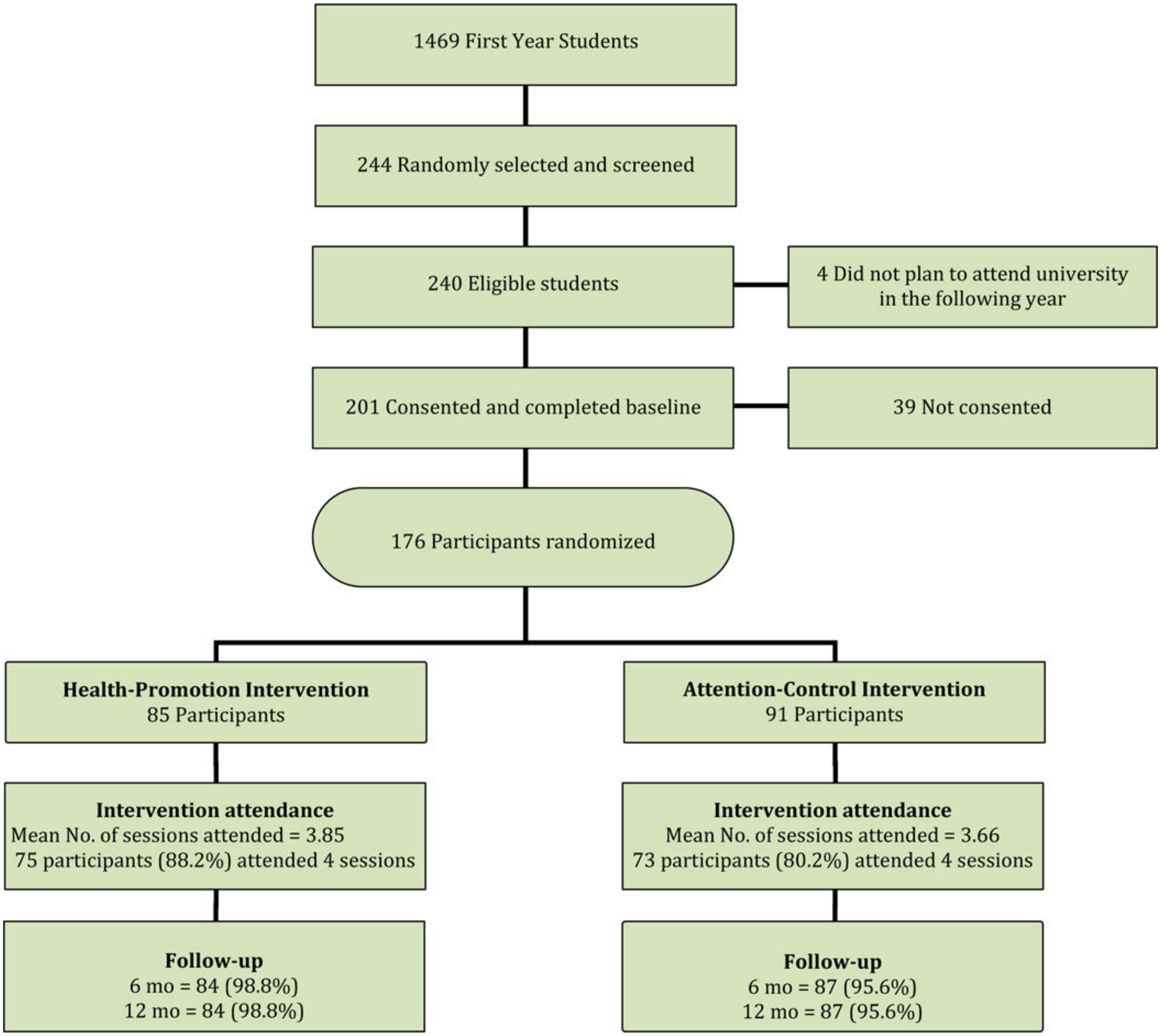

Figure 1:
Flow of participants through the trial.

Table 1.

Outline of the Wake-up Health-Promotion intervention

Module	Title	Components
1	Getting to know you-me and my life	Introduction of program Established group rules Introduce "Wake Up" theme Identify participants' short and long-term life goals, obstacles to goals and their solutions.
2	Nutrition: You are what you eat	Life on Campus Health Risk Assessment Eating better 5-a-Day Diet
3	Nutrition: Planning & Budget	Eating healthy: Barriers & Solution Introduction to Time Cooking Healthy on Campus
4	Exercise: You are what you do	Assessment Physical Activity Video on Physical Activity Physical Activity Fitness Benefits of Exercising Attitudes about Exercise
5	Exercise: Planning & Budget	Aerobic Workout Exercising on Campus
6	Alcohol: You are what you do	Alcohol Intake Assessment The Health Risks of Alcohol Limiting Alcohol Intake
7	Staying committed to your health	Personal Health Goals Barriers & Solutions Peer and partner pressure Rugby Review Activity
8	Review and closing Review	Closing activity-Letter to Self Commitment to healthy life style Closing ceremony

Table 2.

Sociodemographic characteristics and self-reported behaviors of participating students at baseline, by intervention condition, Alice, South Africa, 2009.

Characteristic	HIV Control Intervention (N1=91)	Health Intervention (N2=85)	Total (N=176)
No. (%) Female	47 (51.7%)	47 (55.3%)	94 (53.4%)
Mean Age (SD), years	20.8 (1.52)	20.9 (1.46)	20.8 (1.49)
No. (%) Nationality			
South Africa	34 (37.4)%	30 (35.3%)	64 (36.4%)
Zimbabwe	49 (53.8%)	53 (62.4%)	102 (58.0%)
Other	8 (8.8%)	2 (2.4%)	10 (5.7%)
No. (%) Lives on campus/hostel	76 (83.5%)	76 (89.4%)	152 (86.4%)
No. (%) Lives with steady partner	7 (7.7%)	6 (7.1%)	13 (7.4%)
No. (%) Mother completed high school	40 (47.6%)	35 (44.3%)	75 (46.01%)
No. (%) Father completed high school	38 (59.4%)	43 (59.7%)	81(59.6%)
No. (%) Attends church at least weekly	63 (69.2%)	65 (76.5%)	128 (72.7%)
No. (%) Alcohol dependent (CAGE GE 2)	35 (38.5%)	28 (32.9%)	63 (35.8%)
No. (%) Dagga past 30 days	3 (3.3%)	4 (4.7%)	7 (4.0%)

Table 3.

Health Behaviors by Intervention Condition and Assessment Period, University Health Promotion Program, Alice, South Africa 2008-2010.

Variable	Baseline	6-Month	12-Month
No. (%) meeting physical activity guideline in past 7 days			
Health Intervention	14 (16.47)	26 (30.95)	28 (33.33)
HIV/STD Intervention	17 (18.68)	21 (24.14)	19 (21.84)
P value		.255	.048
Mean (SE) days intensive cardiovascular physical activity in past 7 days			
Health Intervention	1.21 (0.19)	2.58 (0.25)	2.51 (0.25)
HIV/STD Intervention	1.63 (0.20)	2.02 (0.20)	2.06 (0.22)
P value		.026	.033
Mean (SE) days moderate cardiovascular physical activity in past 7 days			
Health Intervention	3.31 (0.31)	3.32 (0.28)	3.44 (0.28)
HIV/STD Intervention	2.63 (0.27)	2.98 (0.26)	2.49 (0.25)
P value		.658	.036
Mean (SE) days strength-building physical activity in past 7 days			
Health Intervention	1.26 (0.21)	1.87 (0.24)	2.15 (0.26)
HIV/STD Intervention	1.29 (0.17)	1.76 (0.21)	1.53 (0.20)
P value		.751	.052
No. (%) 5-a-Day fruit and vegetables in the past 30 days			
Health Intervention	25 (29.41)	20 (23.81)	17 (20.48)
HIV/STD Intervention	17 (19.10)	11 (12.64)	10 (11.49)
P value		.152	.287
Mean (SE) servings of fruit per day in the past 30 days			
Health Intervention	2.22 (0.24)	1.97 (0.23)	1.88 (0.26)
HIV/STD Intervention	1.75 (0.24)	1.47 (0.18)	1.31 (0.16)
P value		.194	.179
Mean (SE) servings of vegetables per day in the past 30 days			
Health Intervention	1.41 (0.14)	1.13 (0.13)	1.59 (0.25)
HIV/STD Intervention	1.13 (0.10)	1.11 (0.13)	1.07 (0.13)
P value		.823	.092

Variable	Baseline	6-Month	12-Month
Mean (SE) servings of fried food per day in the past 30 days			
Health Intervention	0.49 (0.09)	0.33 (0.05)	0.42 (0.06)
HIV/STD Intervention	0.51 (0.08)	0.52 (0.10)	0.45 (0.07)
P value		.093	.811

Table 4.

GEE Empirical Significance Tests and Effect Size Estimates for the Intervention Effect Averaged Over the 6- and 12-month Follow-up Assessments Unadjusted for Baseline Prevalence and Adjusted for Baseline Prevalence, Alice, South Africa 2008-2010

	Unadjusted for Baseline			Adjusted for Baseline		
Outcome	**Estimate (95% CI)**	**Cohen's *d***	***p* value**	**Estimate (95% CI)**	**Cohen's *d***	***p* value**
Met physical activity guideline	2.82 (1.12, 7.11)	0.63	.028	3.35 (1.33, 8.41)	0.73	0.010
Days vigorous aerobic activity	1.66 (1.11, 2.50)	0.38	.014	2.01 (1.43, 2.83)	0.64	<0.001
Days moderate aerobic activity	1.59 (1.13, 2.23)	0.41	.008	1.40 (1.01, 1.95)	0.31	0.044
Days strength-building activity	1.52 (0.97, 2.37)	0.28	.067	1.37 (0.91, 2.07)	0.23	0.128
Met 5-a-Day guideline	1.34 (0.53, 3.38)	0.18	.540	0.98 (0.35, 2.73)	−0.01	0.966
Servings of fruit per day	0.04 (−0.66, 0.75)	0.02	.905	−0.16 (−0.81, 0.48)	0.07	0.622
Servings of vegetables per day	0.05 (−0.52, 0.63)	0.03	.853	−0.06 (−0.64, 0.52)	0.03	0.836
Servings of fried food per day	−0.32 (−0.61, −0.04)	0.34	.027	−0.31 (−0.60, −0.02)	0.32	0.037

Note. Estimate = Odds ratio (Health intervention versus HIV/STD control) for binary outcome variables meeting physical activity and 5-a-Day diet guideline; estimate = risk ratio (Health intervention versus HIV/STD control) for count variables number of days of vigorous aerobic activity, moderate aerobic activity, and strength-building activity; estimate = mean difference (Health intervention - HIV/STD control) for continuous outcomes on other health behaviors. Cohen's *d* =is an effect size estimate in standard deviation units calculated using the Cox method for odds ratios and the *Z* test statistic and N from the GEE analysis for continuous and count variables. Physical activity is in the past 7 days. Diet is in the past 30 days.